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A Micro-Typology of Pluractionality

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A Micro-Typology of Pluractionality

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by

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ABSTRACT OF THE THESIS

A Micro-Typology of

Pluractionality

by

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Master of Arts in Linguistics

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Professor Jessica Rett, Chair

Pluractionality, a specific type of event plurality, is at best only partially understood. In this thesis, I survey four pluractional languages in order to compare and contrast them in search of generalizations across the pluractional strategies. I divide the pluractional markers between canonical and non-canonical pluractional strategies, and use the previous analyses of three of the four languages under discussion to build an analysis for never before seen pluractional data from Bole, a West Chadic language spoken primarily in Nigeria. Along the way I fashion a new analysis for Chechen using the tools provided in Henderson (2010) for Karitiana and Kaqchikel. My analysis of Bole is presented in both a static and a dynamic framework, showing how the analysis transcends framework limitations.

The thesis of Kaeli Shannon Ward is approved.

Edward Keenan

Russell Schuh

Jessica Rett, Committee Chair

University of California, Los Angeles

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1 Introduction

I have three major goals in writing this paper. Firstly, I will summarize a small typology of the semantics of pluractionality. I will show both canonical and non-canonical types of pluractionality and explore how to provide a formal semantic account of each type. My second goal is to present and update a new approach to the semantics of pluractionality as seen in Henderson 2010, 2011. The approach is updated to deal with data from Chechen, a language that Henderson does not set out to account for. In so doing, I will also provide new evidence for borrowing μ from degree semantics for the analysis of pluractionality. My final goal is to show new data for Bole and explore how Henderson's proposal can be extended to deal with an unusual pluractional affix found in Bole.

Pluractionality is most often described as the phenomenon of plural events. However, what exactly does it mean to be a plural event? In the individual domain, plurality is a well studied science, and yet there are still competing theories as to the best formalization of the structure of the individual domain and how exactly to implement plurals. Regardless of theory, though, there is a level at which plurals in the individual domain are clear: if you have more than one of something, there is a plurality of that thing.

Plural individuals are not the only plurals in natural language though. Consider the following English sentence:

(1) Mike pushed Ryan three times.

In this example, there is a plurality, but it is not of individuals; it is the three happenings of Mike pushing Ryan. In English, this concept of plurality of happenings can be expressed in many ways, although there is no systematic way of marking the verb to indicate this. In languages like Karitiana, Kaqchikel, Chechen, and Bole, on the other hand, there is a

way of systematically marking verbal plurals, and these verbal affixes are called pluractional markers. A verb marked thusly is called a pluractional. The following example from Bole (West Chadic, Nigeria) shows a simple/pluractional verb pair.[1]

(2) a. Josh zúrú-wò.
josh laugh-3sm.COMP[2]
'Josh laughed.'

b. Josh zú-zúrú-wò.
josh PVR$_{PLRC}$-laugh-3sm.COMP
'Josh laughed repeatedly.'

Bole has several pluractional markers, of which PVR is one. PVR stands for partial verbal reduplication. I will mention another marker later in this section, and then will go in depth into the distribution and meaning of the different pluractional markers in Section 5. Comparing the two sentences in (2) it is clear that the added meaning of plural happenings comes from the reduplicative morphology, that is, the pluractional marker. In (2b) the addition of the first *zú* indicates that the laughing was done more than once; in fact, this sentence cannot be uttered truthfully in a single-laugh scenario. This is a clear parallel to plural individuals. The cardinality of happenings is more than one, and thus there is a plurality of some kind.

The interpretation of (2b) and other propositions like it leave open the question of what precisely the pluractional marker is making plural. I have been discussing these examples

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[1]All Bole examples come from my own fieldwork unless otherwise specially noted. All Karitiana and Kaqchikel examples are from Henderson 2010 except where specially noted, and all Chechen examples are from Yu 2003.

[2]Glosses used in Bole- ø: null, 3: third person, C2: second consonant gemination, COMP: completive aspect, f: female, *gi*:gi infixation, m: male, O: object, p: plural, PL:plural agreement, PVR: partial verbal reduplication, s: singular, S: subject, X$_{PLRC}$: pluractional marker. Anything offset in angle brackets (< >) is an infix.

on an intuitive level, but there must be a formal level for the semantics of pluractionality. Many (Lasersohn 1995, Henderson 2010, Collins 2001, and others) have proposed that the argument of a pluractional is an event, and this is the tool that I will be using throughout this paper as well. Using events, the proposition denoted by (2b) will be true in a scenario where Josh is the agent of plural events of a laughing nature.

If that was all there were to pluractionality, it might not be all that exciting (although people are still working on nominal plurals, so that's not entirely clear). However, pluractionality shows itself in many ways across the worlds languages.

Take the following example, again from Bole:

(3) Màté já-j-án-gò.
3pS PVR$_{PLRC}$-run-PL-COMP
'They each ran.'

For this pluractional, there is no requirement on how many times each person ran. The sentence denotes a true proposition in a scenario where there are multiple individuals, and each ran at least once. Even though it is not necessarily the case that any given person ran more than once, this counts as multiple happenings, similar to (2b), because there is more than one running, the separate runnings being distributed over individuals. Any reading such as this one will be called a distributive reading, since the events distribute over the participants, that is, each singular event has a singular participant (some pluractionals distribute over subjects while others distribute over objects). In Bole, this distributive reading is not marked by a separate distributive pluractional marker, but languages vary with respect to how they morphologically encode distributive pluractionals.

In (3), the pluractional marker was interpreted distributively, but there is nothing special about PVR that requires this, as we saw in (2b). However, there are pluractional markers that can only be interpreted distributively. The following is an example from Kaqchikel

(Mayan, Guatemala):

(4) Xe'in-kam-**ala'** ri sanïk.
INFL-kill-**PLRC**$_{Dist}$ the ant.
'I killed the ants individually.'

For this sentence to be uttered truthfully, there need to be multiple events of ant-killing, and each killing event can only have one ant as its victim. The predicate is necessarily distributive, and Henderson 2010 has an analysis of how such a necessarily distributive pluractional marker works.

Kaqchikel also has a pluractional marker that does not require distributivity, as in the following:

(5) Xe'in-chap-acha'.
INFL-touch-PLRC
'I touched them repeatedly.'

In this example, there is no requirement that each touching event have a singular participant as its object; the predicate does not need to be interpreted distributively. I bring this up because Bole is the opposite of Kaqchikel. It has one marker, PVR, that does not care about distributivity, as evidenced in (2) and (3). This is similar to (5) for Kaqchikel. However, unlike Kaqchikel, Bole has a pluractional marker, the C2 pluractional (so named because it geminates the second consonant of a root), which prefers[3] collective subjects.[4] A collective subject is a subject that cannot act distributively; more specifically, every singular event must have the entire plural subject as its subject. The following is an example:

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[3]This generalization is based on preliminary evidence. More fieldwork is necessary before this claim can be fully supported.

[4]Collective subjects have also been called cumulative subjects in the literature (c.f. Schwarzschild 1994, Schein 1993).

(6) Màté gàɗ-<ɗ>-án-gò
3pS pass.by-<C2$_{PLRC}$>-PL-COMP
Scenario: Shelley and her friends are walking in a group, so I see them all pass together at once.

This sentence cannot be uttered truthfully in a scenario where each person passes individually. It must be the case that they all pass together. So while Kaqchikel has a specially distributive pluractional marker, Bole has a specially collective marker. For both languages, the other reading (distributive for Bole and collective for Kaqchikel) is a sub-case of the general pluractional marker.

This limited data set shows us that there are options in the typology of pluractionals: a pluractional marker can be distributive, collective (anti-distributive, to look at all in terms of a single parameter), or neither. One question of this paper is how to get this three way distinction in the semantics of pluractionality. The goal is to show that neither a special distributive nor special collective operator is needed to capture the novel data seen for Bole in Section 5.

To achieve my first goal of presenting a small typology of pluractional languages, I will start by discussing pluractionality generally and summarizing two opposing perspectives on the open question of what qualifies as a pluractional. As we will see, more than one happening occurring is not a sufficient description, although it is a good starting point. After that, and in keeping with my second goal of presenting Henderson 2010, I will show data from Kaqchikel and Karitiana (Tupi, Brazil) as they are described in Henderson 2010, as well as data from Chechen and Bole, interspersing this with a summary of the formal tools that Henderson 2010 uses to deal with these pluractionals. I start with more canonical pluractionals and leave discussion of non-canonical pluractionals until the end of the paper. I will use a third pluractional language, Chechen (North Caucasian, Chechnya), to show

how Henderson's formalism can be extended with a μ operator parallel to that found in degree semantics for measuring individuals. Finally, I will look at less canonical pluractional cases, namely distributive pluractionality in Kaqchikel and C2 pluractionality in Bole. Using the tools from Henderson, I explore whether or not the semantics can be extended to deal with Bole pluractionality and address the distributive/collective problem. Ultimately, I will conclude that the semantics of Bole pluractionality can be captured either statically or dynamically, and that no special collective or distributive operator is necessary.

2 Pluractionality

Before formalizing the semantics of particular languages' pluractional markers, let's look at pluractionality in general: what do others characterize as pluractionality, and what are some criteria for knowing that a language has pluractionality? In an attempt to stay theory neutral, in this section only when I refer to an event I mean it in the intuitive sense, i.e. what I called a happening in the introduction.

As we saw above, pluractionality can mark at least three separate phenomena on the verb in Bole – distributivity, collectivity and repeated action. So how do we know what counts as pluractionality? At the moment, there is no straightforward answer to this question, as the literature is in a place of disagreement over the matter. Take as a small sample the following two opinions:

> "Pluractional markers do not reflect the plurality of a verb's arguments so much as plurality of the verb itself: the verb is understood to represent the occurrence of multiple events." (Lasersohn 1995 p241)

> "...it may serve to indicate not only the repetition of an action, as we might expect if our idea of event plurality were limited to the notion of frequency, but a

> whole range of other meanings: repetitiveness, repeated occasions and events, inchoativity, cumulative result, intensity, augmentation, dimunition." (Cusic 1981 p74)

To be more specific, Cusic has a very broad concept of pluractionality while Lasersohn would put comparatively little under the title. The disagreement comes in part from the fact that the lines between pluractionality and other verbal phenomena like aspect are oftentimes blurry. For example, as we will see in Chechen, pluractionality can sometimes surface with a durative meaning. This pluractional marker does not require a multiple event scenario for the proposition it is a part of to be true; instead, it is true in a scenario in which an event takes place longer than usual. Cases like these are where disagreements are common. In the rest of this section, I will summarize small portions of the the oft cited pluractional references Wood 2007 and Cusic 1981 to give an overview of the phenomenon under discussion as well as two different possible viewpoints on pluractional data.

I first discuss Cusic 1981 and Wood 2007 simultaneously as they cover the same sort of introduction to pluractionality. All of the upcoming ideas and data are theirs (Cusic ch's 2 and 3, Wood ch 1). To begin, there are many ways that English expresses verbal plurality:

(7) a. Three children woke up. [Multiple awakenings]
b. Ryan is knocking on the door. [multiple knocks]
c. Marijke came to visit many times. [multiple instances of visiting]
d. He jumped and jumped. [multiple jumps]
e. Mary often visited her mother. [multiple visits]

However, these strategies (plural NPs, progressive, etc) can also be used without expressing event plurality:

(8) a. Jacob liked the apples.

b. Nora is running.

In fact, it might be possible to argue that the multiple eventhood of the examples in (7) is parasitic on other elements of the sentence: argument structure, aspect, verb category. In other languages, though, there are special constructions that are only used to express event plurality. Thus, the main area of pluractional study is focused on affixes that unambiguously mark a multiplicity of events. Not everyone agrees with this cutoff though.

Wood discusses a case where certain verb forms within a language require a plural argument, for example in Southern Paiute. In S. Paiute, there are suppletive verbal stems that designate that the absolutive argument is plural, and this suppletive system is distinct from the agreement system.

(9) a. watcï – to put one (object)

yun·a – to put several (objects)

b. qarï – one sits, dwells

yuɣwi – several sit, dwell

Wood claims that this phenomenon is separate from pluractionality because it does not necessarily require a plural event. However, the similar phenomenon of distribution of events over participants or locations, as is found in Yup'ik, is claimed to be pluractional because the distributive meaning necessitates a plural event.

(10) a. ayag – to leave

ayakuut – 'they are leaving one after another'

b. tekite – to arrive

tekitequut – 'they keep arriving one after another'

Given the distinctions shown above, it can be said that Wood has a fairly strict interpretation of pluractionality. Please see Wood 2007 for much more discussion.

Cusic, on the other hand, encompasses much more under the umbrella of pluractionality, as we saw in the quote above. Cusic claims that there are three main types of pluractionality, and all of the readings discussed above fit into one of these three categories: external plurality, also known as plurality **of** events (11a), internal plurality, or plurality **in** events (11b), or both (11c):

(11) a. The mouse bit the cheese again and again.

b. The mouse nibbled and nibbled the cheese.

c. The mouse was always nibbling the cheese.

This major distinction becomes the first of Cusic's four parameters that he uses to categorize the many plural meanings. It is called the phase/event/occasion parameter (also known as the event ratio parameter). See Cusic 1981 for a full discussion of the four parameters, as they will not be used in the analysis for this paper. Getting back to the central debate, Cusic views the following (which are varied readings of the same morpheme) from Potowatomi as all cases of pluractionality:

(12) a. nka koki – 'I dive in often'

b. ntummu mmačkona – 'I hold him tight'

c. ntupsu psutake – 'I keep my mind on it constantly'

d. nna na nipuwu – 'I stand up repeatedly'

While (12d) is a standard pluractional reading, the other three are not unambiguously pluractional. Cusic is somewhat of an outlier in how permissive he is of pluractional readings, and I take a stance more akin to Wood's on the subject.

Newman (1990) discusses the generalizations of pluractionality across many Chadic languages, of which Bole is one. The unifying theme for describing pluractionals is (not surprisingly) plurality of process or action (p54). Looking at specific languages, he shows that common descriptions of pluractionals include: distributive, intensive, iterative, or extensive. Bole fits cleanly into Newman's generalizations. There are a couple pluractional markers in Bole which can have (at a minimum) distributive and iterative readings. Bole also agrees with the Chadic typology in that it can express pluractionality by reduplication and gemination. Newman claims that reduplication is the most common way of marking pluractionality in the Chadic languages and that gemination is a subcategory of reduplication. The following is another example of Bole pluractionality:

(13) Bryon bì-bìɗ-áa àdà
Bryon PVR$_{PLRC}$-untie-3sm.COMP dog
'Bryon untied his dog repeatedly.'

While I have glossed this for the moment as "to untie repeatedly," I'll show later that the range of uses for pluractionals is more complicated than that.

The unifying theme throughout all of the data introduced above is that its analysis is based the assumption that pluractionality is a plurality of happenings. Whatever one wants to call these, there is something that corresponds to the action denoted by a predicate, and this thing can occur in plural forms as well. I will call this entity an event, following standard pluractional practice. In the next section, I will review aktionsart classes, because, as we will see for Kaqchikel, the aktionsart class that a predicate belongs to can effect how it interacts with a pluractional affix. In the following sections I will outline the data and analysis of Karitiana and Kaqchikel as they will provide points of comparison and contrast for Bole. I will also make a small diversion into the data of Chechen to show how Henderson's analysis can be extended in simple ways to deal with new languages.

3 Events and Aktionsart

As I stated above, I will be using events in my analysis of Bole, following the lead of most analyses of pluractionality given so far. For those readers to whom is is not clear why events are a natural or necessary part of the ontology, I refer you to those who have argued for their usefulness before me: Bayer 1996, Landman 1993, 2000, Parsons 1990, and others. This is not to say that an event-based account is the only way to go. I imagine that similar and effective arguments could be made from the perspective of situations (Kratzer 1989) or from ordered pairs of indices. However, I will not be pursuing these options in this paper. I will use events in my ontology, and they can be short for whatever the reader prefers.

As I said above, I'd like to do a review of aktionsart classes. One might wonder why aktionsart classes are important to pluractionality. For one thing, in pluractional languages, stative verbs are frequently incompatible with pluractional morphology. Chechen, as will be shown below, is an exception to this rule. Take the following failed attempt at pluralizing a stative from Bole:

(14) *Josh gà-gàanú-wò
josh PVR$_{PLRC}$-understand-3sm.COMP
Intended meaning: 'Josh understood repeatedly/often/for a while.'

As we will discuss in the next section, pluractional markers also have the ability to change the aktionsart class of the underlying predicates they pluralize.

This discussion is based on the distinctions made by Vendler (1967), some of the expansions on those ideas since, and the ontology presented in Moens and Steedman (1988). I will start with the Vendlerian distinctions.

Vendler originally proposed a four-way distinction for verbs: states, activities, accomplishments, and achievements. They are typically distinguished across two parameters: is

the verb telic (compatible with *in an hour*) or atelic (compatible with *for an hour*); is the verb (or is it not) comfortable in the progressive?

(15)

	Progressive	Not Progressive
Telic	Accomplishment *drown*	Achievement *realize*
Atelic	Activity *run*	State *love*

(16) a. ✓He was drowning. He drowned *for an hour/✓in an hour.

b. * He was realizing the answer. He realized the answer *for an hour/✓in a hour.

c. ✓She was running. She ran ✓for an hour/*in an hour.

d. * She was loving him. She loved him ✓for an hour/*in an hour.

It is important to recall that these are the verbs in their canonical usage. It is often possible to "coerce" a verb into a different aspectual class. Comrie 1976 goes on to add one more category to the aktionsart classes: semelfactives, an example of which is *knock*. These are special because while they are grammatical in the progressive, a repeated event event reading arises instead of an extended event reading. Consider *I was knocking for an hour* versus *I was running for an hour*. The former does not indicate the a single knock took an hour, but rather that there were multiple knocks and they added up to an hour of knocking.

Now that there is a basic foundation of aktionsart classes, in order to understand Henderson's formalisms we need to break them down in one more way. Moens and Steedman argue that events are composed naturally of combinations of three parts: preparatory process, culmination, and consequent state. These three pieces make up what is called a full event nucleus. The event nucleus is all of the parts of an event, and to have a full event nucleus is

to have all three possible pieces. A full event nucleus is equal to a Vendlerian accomplishment, and the rest of the aktionsart classes can be broken down into their component parts as well. The following, Figure 1, is a visual representation of a full event nucleus, and the table following that, (17), shows which parts of an event nucleus each aktionsart class has:

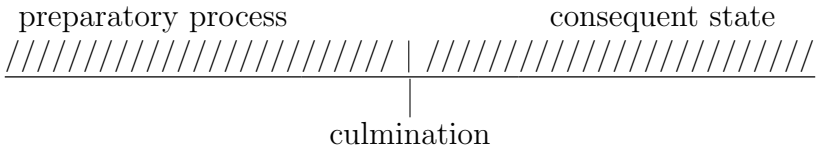

Figure 1: Internal Accomplishment Event Structure

(17)

Aktionsart Class	Prep Process	Culmination	Cons State
Accomplishment	X	X	X
Achievement		X	X
Semelfactive		X	
Activity	X		
State			X

This table will come in handy in the next section when defining the structure of the event domain as explained in Henderson. With a firm grasp of aktionsart, it is time now to move on to the structure of the event domain and the data that motivates it.

4 Canonical Pluractionality, in Henderson's Terms

In this section I aim to show the tools that Henderson 2010 uses and invents to account for the data of two pluractional languages, Karitiana and Kaqchikel, as well as show how these same tools can be used or extended for the canonical pluractionals found in Chechen and

Bole. Henderson 2010 has three major parts: developing a structure for the event domain, creating a static analysis for Karitiana and one marker of Kaqchikel, and then formulating a dynamic analysis for the other Kaqchikel pluractional marker. The dynamic analysis I leave until section 6, on specialized pluractionals. I will begin with the data that motivates the structuring rules for the Karitiana and Kaqchikel's standard pluractional markers. Then I will lay out these rules and how they translate into analyses of the data presented. Next, I will look at data from Chechen, a pluractional language that Henderson did not use for his analysis, and show how the analysis can be changed and extended to account for this new language data. Finally I will show new data from Bole and provide a semantics of one of Bole's pluractional markers based on the tools developed earlier in this section.

4.1 Karitiana

Pluractionality in Karitiana is usually indicated by total verbal reduplication. The following minimal pair illustrates the way the pluractional semantics excludes single event scenarios. (18) can be uttered truthfully if two eggs are broken in a single dropping event while this same scenario would make an utterance of (19) false. This is because (19) requires multiple events, and as there are only two eggs, each needs to be involved in a separate breaking event.

(18) Õwã naka-kot sypomp opokakosypi
kid 3.DECL-break.NFUT two.OBL egg
'The kid broke two eggs.'

True if the eggs broke simultaneously.

(19) Õwã naka-**kot-kot** sypomp opokakosypi
kid 3.DECL-**break-break**.NFUT two.OBL egg[5]
'The kid broke two eggs (in separate events).'

False if the eggs broke simultaneously.

The point of this data is to show that Karitiana, unlike many pluractional languages, has a simple non-atomicity requirement. In layman's terms, two events are enough to satisfy the pluractional's multiple event requirement. As will be shown shortly, this is not the case for Kaqchikel. First, the other main data set for Karitiana:

(20) Pikom kyn na-pon-pon õwã.
monkey POS 3.DECL-shoot-shoot.NFUT kid
The kid shot at the monkeys.

False if only one shot was taken **(Semelfactive)**

(21) Dibm naka-hor-i sypomp õwã.
tomorrow 3.DECL-go.PLRC-FUT two kid
Two kids will leave tomorrow.

False if there is only one leaving **(Achievement)**

(22) Õwã naka-m-'a-m-'a-dn gooj.
kid 3.DECL-CAUS-build-CAUS-build-NFT canoe
The kids build canoes.

False if only one canoe got built **(Accomplishment)**

There are two reasons for this data set: first, it shows that three of the five aktionsart categories are compatible with the pluractional marker in Karitiana. While there is no data showing failed attempts at pluractionalizing states and activities, Henderson 2010 leads me to believe that such a pluractional is not possible. Secondly, the pluractional marker takes an underlying predicate and ensures that there is a multiplicity of the same type of event. Semelfactives stay semelfactives, and the same goes for achievements and accomplishments.

[5]At this point, Henderson uses reduplication in the gloss to indicate pluractionality.

This leads to the conclusions that the pluractional marker is taking whole events and pluralizing them, rather than targeting just a part of an event. Thus, if an event is composed of a culmination and consequent state (i.e is an achievement), then adding the pluractional morphology to this will result in a multiplicity of culminations and consequent states, but not of consequent states alone. Henderson concludes that achievements, accomplishments, and semelfactives must be the event atoms, and single events of these types can be parts of plural events of the same type. To account for this, Henderson builds the following semi-lattice ordering for the event domain (basically parallel to the semi-lattice for individuals in Link 1983 and also similar to that of events from Bach 1986).

First, let us define EV, a non-empty set of eventualities made up of non-empty subsets S (states), A (activities),[6] and E (events) such that $S \cup E \cup A = EV$. Notice that E is composed of achievements, accomplishments, and semelfactives, exactly those aktionsart classes that can be targeted by Karitiana pluractionals. Henderson does not make the following assumption, but I have found that the structure he creates does not work properly without it, so following fairly standard practice, for example Bach 1986, assume EV is a join-semilattice without a lowest element. Recall that by definition any set (and more specifically any two elements) has a unique supremum or least upper bound. Continuing with Henderson's analysis, let proper part $<$ be a transitive ($a < b < c \Rightarrow a < c$), irreflexive ($\forall x \in X, x \not< x$), binary relation on EV such that the following definitions hold. Note, it is not crucial to the reader's understanding of the paper as a whole that these definitions are fully comprehended. They are included for the sake of completeness.

(23) Part: $x \leq y := x < y \vee x = y$

[6]Henderson calls this the set of processes, P, since activities are made up only of a process in the event nucleus sense.

(24) Overlap: $x \circ y := \exists z(z \leq x \wedge z \leq y)$

(25) Disjoint: $x \int y := \neg(x \circ y)$

(26) Sum: Sum: $x \oplus y :=$ the z such that z is the unique supremum of $\{x, y\}$[7]

(27) Set Sum: $\oplus P :=$ the x such that x is the supremum of $\{y \mid y \in P\}$

The last definitions prevent an empty part (28) and ensure that any two elements of EV have a sum (29):

(28) Axiom (Supplement): $\forall x \forall y(x < y \rightarrow \exists z(z < y \wedge z \int x))$

(29) Axiom (Sum Existence): $\exists x(P(x) \rightarrow \exists y(\oplus P = y))$

This concludes the definition of $<$ in general, so let's take a moment for a real world example. Given an event of jumping repeatedly, say jumping rope, each individual jump would be a part of the total rope jumping event. Call the rope jumping event e and the first jump e'; then $e' < e$, i.e. a single jump is a part of the whole rope jumping event.

A semi-lattice is standardly defined with set of atoms, and these atoms are the things which a plural marker targets to pluralize. Define AT a non-empty subset of EV which is picked out by the function $\mathbf{atom}_{\leq}$ to be the atoms of $\leq$. The atoms of this ordering are

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[7] Henderson's original version of this rule is:

(i) Sum: $x \oplus y :=$ the z such that $\forall u(u \circ z \rightarrow (u \circ x \vee u \circ y))$

but I can prove this to be inaccurate as both x and y satisfy the formula for this z, which proves it is not unique. Furthermore, it basically does not find the element that I believe Henderson is looking for. Henderson's version of (27) is:

(ii) Set Sum: $\oplus P :=$ the x such that $\forall y(y \in P \rightarrow y \circ x)$

I think this definition will hold in a join-semilattice, but in the interest of keeping things parallel, I have included my own definition of this as well.

defined as *mereological atoms*.

(30) Mereological Atom: $\mathbf{atom}_{\leq}(x) \iff \forall y(y \leq x \rightarrow y = x)$

Essentially, something is an atom if it is at the bottom of the lattice, i.e., a singular event. Henderson stipulates that the set of atoms is coextensive with the set E of eventualities, thereby defining semelfactives, achievements, and accomplishments as atoms, states and activities as non-atoms. This is because only semelfactives, achievements, and accomplishments are possible targets of pluractionality. Therefore they must be atoms and must be the only atoms.

Notice that while accomplishments and achievements (atoms) have consequent states and/or processes as parts of their event nuclei, the aktionsart classes of states and activities are not atoms themselves. That is because the ordering is looking at the entire event nucleus, not at the internal parts. Since semelfactives, achievements, and accomplishments are defined as atoms, it does not matter what is inside of them. Henderson does introduce a second ordering relation that can look inside an event nucleus in ways that $\leq$ cannot, but this ordering is not crucial to my analysis of Bole or Chechen, so I refer you to Henderson 2010 for details.

This concludes the ordering relation introduced to handle the Karitiana data, and I can now move on to Henderson's analysis thereof. In order to proceed, Henderson makes the following assumption, following Krifka (1986), Landmann (1996), and Kratzer (2005), among others: all predicates are underlyingly cumulative.

(31) For any predicate $P, *P$ is the smallest set such that $P \subseteq *P$ and for all x, y, if $x \in *P$ and $y \in *P$ then $x \oplus y \in *P$

(32) For any natural language predicate *pred*: *pred* $\rightsquigarrow$ *PRED

Recall, the Karitiana pluractional only adds a clause to the logical form requiring that the event be a non-atom (i.e. have two or more sub-events). Thus, the following is a derivation of the predicate *m-'a*, 'to build,' with a pluractional marker and *gooj*, 'canoes,'[8] as its object:[9]

(33) a. $[\![m'a]\!] = \lambda x \lambda e. * \textsc{m'a}(e) \wedge \textsc{th}(e, x)$

b. $[\![m'a]\!]([\![gooj]\!]) = \lambda e. * \textsc{m'a}(e) \wedge \textsc{th}(e, g)$

c. $[\![PLRC]\!]([\![V]\!]([\![j]\!])) = \lambda e. * V(e) \wedge \textsc{th}(e, j) \wedge \neg \mathbf{atom}_{\leq}(e)$

d. $[\![PLRC]\!]([\![m'a]\!]([\![gooj]\!])) = \lambda e. * m'a(e) \wedge \textsc{th}(e, g) \wedge \neg \mathbf{atom}_{\leq}(e)$

Notice that in introducing the pluractional, I am using predicate modification rather than function application. From (33a) to (33b) I simply use function application to fill the object theta role. From (33b) to (33c), I use predicate modification to add a clause requiring that the event be non-atomic. Finally, (33d) includes the actual verb in question. The result is a set of events rather than a proposition because I am only deriving the verb phrase itself. I have not yet included an external argument or existential closure.

This formula will be true of any event of cardinality two or more. Also, since the pluractional is defined with respect to the $\leq$ relation, any member of E can act as the atom that the pluractional pluralizes (as was wanted) and the aktionsart profile of the underlying predicate is untouched since the pluractional operates on event nuclei as wholes (why this is important will become evidently shortly). This analysis will shape the later analysis of Chechen's pluractional and Bole's PVR pluractional. This is a simple case of pluractionality

[8]While it is standard to have common nouns denote properties as opposed to constants, this is how Henderson does his derivation, and I don't see that doing so detracts from the semantics of the derivation. Therefore, I leave it as is.

[9]I've changed Henderson's formalism to hopefully make it more transparent. See Henderson 2010 for the original.

and mirrors nominal plurality as it is seen in English in a straightforward manner. As we are about to see, this is not always the case for pluractionals. In the next section, I move on to contrast this with data from Kaqchikel.

4.2 Kaqchikel's PLRC

Kaqchikel pluractionality is rather different from that of Karitiana. This section looks briefly at one of the two pluractional markers of Kaqchikel, here called PLRC. While the data and analysis of Kaqchikel's PLRC are fascinating, only one small facet of the discussion informs my analysis of Bole and so I refer you to Henderson 2010 for more details. I will simply summarize the data since the parallel between Bole and Kaqchikel's pluractional systems stems from the fact that both have two pluractional markers, one more general, or more canonical, and the other more specific. PLRC is the more general of Kaqchikel's pluractional markers, and the more specialized marker will be discussed in Section 6.

PLRC can combine with any aktionsart class that has a culmination. The culmination itself needs to be plural in order for the denotation of the proposition with a pluractional to be true. The following examples show how this works with the three eventive aktionsart classes.

(34) a. X-in-ru-chäp.
CP-A1s-E3s-touch
'He touched me.'

b. X-in-ru-chap-acha'.
CP-A1s-E3s-touch-PLRC
'He touched me repeatedly.'

(35) X-i-tz'uy-utz'a
CP-A1s-sit-PLRC
I sat repeatedly.

Speaker sits up and down rapidly never touching her seat. **(Achievement)**

(36) X-in-qum-uqa' ri kaxlan ya'
CP-A1s-drink-PLRC the coke
I drank at the coke repeatedly.

Speaker holds bottle to mouth, lips closed, and tips it up and down. **(Accomplishment)**

This points to the fact that the Kaqchikel pluractional marker cannot be taking the entire event nucleus as its argument. In fact, it is targeting only the culmination of the event. Therefore, Henderson proposes another ordering relation that can see into a predicate and pick out its culmination as an atom. I will not explore this ordering relation, as it is not necessary for my analysis; again, see Henderson 2010 for details.

Henderson claims that Kaqchikel pluractionals denote group events rather than simple plurals, but the data is too involved to get into. Therefore, I will simply accept this assertion and the ensuing definition that Henderson gives of **group**. Included in the definition of **group** is the fact that a group event is non-atomic. Given that, the following is a translation of the Kaqchikel pluractional marker:

(37) $[\![PLRC - P]\!] = \lambda e.\, \mathbf{group}(e) \wedge *P(e)$

The first conjunct is contributed by the pluractional marker, and the second conjunct is contributed by the predicate itself.

There is one more restriction on Kaqchikel pluractionals. The number of events necessary to make a pluractional true depends both on the predicate and the context. The number is usually intuited by native speakers to be quite large. Therefore, Henderson proposes that there must be something in the logical form that ensures that there are sufficiently many events to meet a contextual standard. To do so, Henderson borrows the μ function from

degree semantics. It is a function from entities to real numbers and indicates in some sense the degree of the argument along a relevant scale, be it weight, length, cardinality, or other, depending on context and the entity being measured. In the case of events, the default measure of μ is assumed to be cardinality, as events with culminations are countable. Hence μ measures the cardinality of an event and requires that this number be at least as big as some contextually valued standard. The new logical form of PLRC is the following, where d ranges over the natural numbers:

(38) $[\![PLRC - P]\!] = \lambda e.\, \mathbf{group}(e) \wedge *P(e) \wedge \mu(e) \geq d$

This accounts for the flexibility of the requirement of the number of repetitions in Kaqchikel pluractionality.

The use of μ is supported by the following, where the same affix that marks the pluractional meaning gives a "high degree relative to a standard" reading to a gradable predicate:

(39) set-es-ik
It is completely circular.
(*set* means circular.)[10]

Similarly 'It is soft' becomes 'It is extremely soft.' In both the pluractional and gradable predicate cases, μ is measuring quantity, but in the pluractional case it is measuring the quantity of events, which is valued in terms of cardinality, whereas in the gradable cases, μ is measuring the quantity of degrees of circularity or softness, neither of which is discrete, and so cardinality cannot be used as the relevant scale. As I will show in Chechen in the next section, further arguments can be made for the use of μ in the analysis of pluractionals.

[10]This example is not glossed because there is no gloss in the original.

This concludes the analysis of this Kaqchikel pluractional marker, as well as all of the static semantic innovations of Henderson 2010. In the next section I will make a brief foray into Chechen, a pluractional language that Henderson did not try to account for, and show how the static approach developed so far (which will also influence the eventual analysis of Bole) can be extended to deal with the Chechen facts.

4.3 Chechen, an Extension of Henderson

In this section, I will be using data from Chechen as it is presented in Yu 2003. The goal is to investigate how the data can be interpreted within the analysis presented in Henderson 2010 for Karitiana and Kaqchikel. Even though Chechen requires a slight revision of the Henderson system, I still consider Chechen to be a canonical pluractional language since it follows the patterns exposited of the previous two sections.

Chechen generally marks pluractionality with ablaut, where the high front vowel of a pluractional/simple pair marks the pluractional. This isn't always the case, but it is a strong tendency. This same pluractional method marks three separate pluractional readings: frequentative, durative, and distributive.

In Chechen, the most common pluractional reading is the frequentative or habitual, meaning simply that the action defined by the predicate was done more than once. Yu does not give more specific details on any possible restrictions of this pluractional, so I will assume that there is a simple multiple event requirement like that of Karitiana. The following show the contrast between a simple verb (40) and a pluractional (41):

(40) as qiigashna **twop-qwessira**
1SG crow.PL.DAT **gun-throw.WP**
'I shot crows.'

(41) as qiigashna **twop-qissira**
1SG crow.PL.DAT **gun-throw.PLR.WP**
'I shot crows many times.'[11]

When a verb is characterized as a frequentative when pluractionalized, then the simple verb that it is the plural of will always have been one of three aktionsart types: semelfactive, achievement, or accomplishment. Yu claims that when each of these three aktionsart classes is pluralized, the resulting plural will be a member of the activity aspectual class. Wood 2007, however, also looks at Chechen and does not draw this conclusion. The verbs when pluractionalized maintain their aktionsart classes, just as they did in Karitiana. I am going to proceed with Wood's (2007) assumptions. Here are some more examples:

(42) aftobas nouqahx siicira
bus road.ADV stop.PLR.WP
'The bus stopped along the road repeatedly.'

(43) adama takhan duqqa'a chai miilira
Adam.ERG today many tea drink.PLR.WP
'Adam drank a lot of tea over and over again today.'

This data should be strongly reminiscent of the data from Karitiana. The pluractional marker imposes a non-atomicity requirement, and the underlying aktionsart classes of the non-pluractional predicates are maintained when pluralized. That is, a semelfactive stays a semelfactive, and the same goes for the other members of E. What is different about Chechen, though, is that this same pluractional marker can take members of S and A (states and activities) as its arguments.

In Chechen, the pluractional morphology can be added to a state or activity. Remember

[11]PLR indicates pluractionality and WP indicates witnessed past, a type of completive. All other glosses proceed as usually expected. All data in this section are from Yu 2003.

that this is not possible in either Kaqchikel or Karitiana. When there is a pluractional state or activity, the pluractional has a durative meaning, which indicates that the action that the verb denotes was executed for a while or continuously.[12] Here are some examples:

(44) Ahxmed jaalx swohxtiahx idira
Ahxmed six hour.LOC run.PLR.WP
'Ahxmed ran for six hours (nonstop).'

(45) cyna chow xiizhira
3SG.POSS wound hurt.PLR.WP
'His wound ached (for a long time).'

Thinking back to the ordering relation developed earlier and its atoms, it should be clear that the durative pluractionals in Chechen cause problems for a Hendersonian semantics of pluractionals. Henderson's pluractionals act only on E – semelfactives, accomplishments, and achievements. States and activities were factored out as separate, although still part of the domain of eventualities. As such, to account for this data an extension of the Henderson pluractional semantics is necessary.

As was discussed above, the semantics of the eventive verbal categories in Chechen seems to mirror that of Karitiana. Therefore, as a preliminary analysis for semelfactives, achievements, and accomplishments, we could start out with the same analysis we had for Karitiana:

(46) aftobas nouq'ahx siicira
bus road.ADV stop.PLR.WP
'The bus stopped along the road repeatedly.'

(47) a. $[\![stop]\!] = \lambda e. * stop(e)$

[12]Yu claims that inceptives and inchoatives also yield durative pluractionals, but this is contested by Wood. In the interest of simplicity I am going to follow Wood in asserting that the durative reading only results from the pluractionalization of atelic predicates.

b. $[\![PLRC]\!]([\![stop]\!]) = \lambda e. * stop(e) \wedge \neg \mathbf{atom}_{\leq}(e)$

However, we also need to deal with the durative data. Remember that states and activities are not considered atoms of the $\leq$ ordering, and so Henderson 2010 cannot account for this data. Therefore, I propose that we extend the domain of pluractional markers to include states and activities. I do not dispute that there is evidence for the ordering and atoms that Henderson has proposed, but there must also be an option for pluractional operators to have a wider domain. Assuming we accept the domain of the Chechen pluractional to include states and activities, it is still necessary to create a logical form for the pluractional that provides the correct pluractional readings based on the underlying predicate that it is applied to.

When comparing simple and pluractional statives or activities, the main difference seems to be one of duration past a contextual standard. So, it is one thing to run, but it is another to run for a (contextually salient) long time. This hearkens back to the discussion of Kaqchikel gradable predicates. When pluractional morphology was applied to a gradable predicate, the reading obtained was one where the degree to which the predicate was satisfied exceeded a contextual standard. This was achieved using a μ operator. I propose the same for Chechen.

Before giving the analysis, though, I'd like to give some background on μ so that I can then explain the wider implications of the use of μ for pluractionality. μ is a function that has been well defined in the degree literature for years (Cartwright, 1975; Cresswell, 1976; Nerbonne, 1995, among others). Take, for example, the measure phrase *two dolphins*. Degree semanticists tend to treat numerals as degree arguments rather than quantifiers as this allows for a unified analysis of numerals as they occur in measure phrases and differentials like *She has two more than he does*. Therefore, the semantics of *two dolphins* is essentially *two* μ

dolphins, and in this case μ tracks the cardinality of the noun since dolphins are discrete units and can be counted. On the other hand, for a mass noun like cookie dough, *two lbs of cookie-dough*, we really have *two pounds* μ *cookie-dough*, and the μ evaluates the quantity of the dough, namely its weight, along a dense scale rather than by cardinality since dough isn't divisible into discrete units.

Furthermore, it is generally accepted that μ is a context given measure function appropriate to the entity under evaluation. Therefore, while we want to functions for height and weight to be different, the measure operator in the syntax remains constant while the μ in the semantics is an arbitrary measure function that picks up the appropriate scale of measurement from the context. Therefore, when one says *two feet of water*, μ does not use a scale of volume or beauty or anything else. The context informs it that depth is the required scale for measurement.

Following the logic outlined above, people (Cresswell 1976, Rett 2008, and others) have argued for a null measure operator that is always present and constant in the syntax that relates individuals to quantity degrees. The following definition of the measure operator is taken from Rett 2008:

(48) M-Op $\rightsquigarrow$ $\lambda d\, \lambda x.\, \mu(x) = d$, where μ, a measurement function, is valued contextually

This null M-Op has as its semantic counterpart the context valued μ, a degree argument defined over quantities of both count and mass nouns that is existentially closed at the end of the utterance if it is not yet bound. The relevant distinction between count and mass nouns can be summarized as follows, based off of Bach (1986): count nouns correspond to things that intuitively denote discrete individuals, like dolphins, children, or MaryEllen and Mike; mass nouns correspond to things that intuitively denote dense things, or "stuff," as Bach calls it. Examples of mass nouns are water, gold, and cookie dough. Since the two types

of nouns are measurable in different ways, μ acts differently depending on which type of noun it is taking as its argument. This account of μ allows it to be consistent with gradable adjectives and adverbs as well as count and mass nouns. As I will show, this same μ is consistent with valuing the degrees of events.

To return to events, Bach extends Link's (1983) account of the count/mass distinction to the domain of events. He considers events, namely achievements, accomplishments, and semelfactives, to be analogous to count individuals while activities are analogous to mass nouns. This comparison can be taken one step farther: if the behavior of μ in the event domain mimics the behavior of μ in the individual domain, then it acts as an additional parallel between the event and individual domains. Nakanishi 2007 makes a similar claim for the parallels between the individual and event domains based on degrees using data from split measure phrase constructions in Japanese, lending further credence to the claims I make in this section.

We know that when μ operates on discrete individuals, then cardinality is the scale along which the contextual standard is evaluated. The same is true for events of the accomplishment, achievement, and semelfactive kinds. These two classes are the same two that Bach draws a parallel between. On the other side of the same coin, when μ acts on both mass nouns and activities, it does not measure cardinality but rather a measurement along a dense scale, be it depth, length, weight, or duration, as the case may be for activities. The only thing left out of all of this is states, but as states and activities are similar in their lack of a telos, it seems that language pairs the two together with respect to how μ views them.

If a μ operator is applied to telic events, then μ tracks the cardinality of the predicate and requires that it exceed a certain number depending on context and predicate. If the μ operator applies to a state or activity, there is no telos, and so cardinality is not a possible means of exceeding a standard. Instead, it tracks the duration of the predicate, exactly as

is desired for Chechen. Using the μ operator in the logical form, then, yields the following as the denotation of the Chechen pluractional:

(49) $[\![PLRC - P]\!] = \lambda e. * P(e) \wedge \mu(e) \geq d$

Thus, repeating (47) but including the revised semantics, the following is the logical form for a pluractional of an accomplishment verb phrase in Chechen before the external argument is added, and the next example shows the translation when applied to an activity verb phrase sans internal argument[13]:

(50) a. $[\![stop]\!] = \lambda x \lambda e. * stop(e) \wedge \text{AG}(e, x)$

b. $[\![PLRC]\!]([\![stop]\!]) = \lambda x \lambda e. * stop(e) \wedge \text{AG}(e, x) \wedge \mu(e) \geq d$

c. This verb phrase requires an agent and existential closure to create a proposition that is true of a *stopping* event such that the cardinality of the event exceeds a contextual standard d.

(51) cyna chow xiizhira
3SG.POSS wound hurt.PLR.WP

[13] I'm assuming that *wound* is the theme of *ache*.

'His wound ached (for a long time).'

(52) a. $[\![xoizhira]\!]^{14} = \lambda x \lambda e. * xoizhira(e) \wedge \text{TH}(e, x)$

b. $[\![PLRC]\!]([\![xoizhira]\!]) = \lambda x \lambda e. * xoizhira(e) \wedge \text{TH}(e, x) \wedge \mu(e) \geq d$

c. This verb phrase requires a theme and existential closure to create a proposition that is true of an event e such that e is an *aching* event and the duration of this event is greater than the standard duration of an *aching* event.

So, what we have shown in this section is that Henderson 2010 provides a good base for a semantic analysis of Chechen, and the changes necessary to account for the new data were straightforward. I've also provided additional support for the use of degrees in the semantic analysis of pluractional predicates. More importantly, though, I've added one more parallel to the list of cross-domain similarities. This concludes the discussion of Chechen, and now we will move on to an in-depth look at Bole, including an analysis of its canonical pluractional marker, PVR. First I will present an overview of Bole pluractionality, as the data I will present is new. Then I will analyze PVR pluractionality. That will conclude the typology of canonical pluractional types, and then I can move on to Sections 6 and 7 where I summarize Henderson's use of dynamic semantics to capture the distributive pluractional marker from Kaqchikel, as this marker is the counterpoint to Bole's C2 pluractional markers.

5 A First Look at Bole

Our discussion now turns to Bole, a West Chadic language of northeastern Nigeria. Bole is spoken by approximately 100,000 to 300,000 people (Ethnologue, Schuh and Gimba 2004–

[14] xoizhira is the simple verb form of the pluractional xiizhira

estimations vary), most of whom live in Yobe and Gombe States. It is an SVO, tonal language without overt case marking on nouns or noun phrases. First and second person subjects trigger a preverbal agreement clitic and third person is marked by a lack of one. In the completive (which all of my examples are in), the verb stem also agrees with the person and number of the subject. Pronominal direct objects are clitics on the verb, as is the case in most of the examples below. The form of the clitic depends on the tense/aspect/mood of the verb as well as other verbal morphology, but I refer you to Schuh 2004 or Gimba 2000 for a more in depth discussion.

Bole has verb classes, and this partition of verbs will come up in our discussion of pluractionality. There are five verb classes, distinguished not by their semantics but by their morphological behavior. So, for example, C and D verb roots are singular consonants with their vowels determined by TAM and/or subject agreement. It is important to make the morphological nature of the verb classes known because certain pluractional strategies are limited by verb class, but we cannot draw any conclusions about their semantics because of this restriction. Thus, when we find that the gemination pluractional strategy cannot occur on class C verbs, we are no closer to understanding the infix's meaning than we were before.

Bole has three distinct morphological means of marking pluractionality on the verb: partial verbal reduplication (53), C2 gemination (54), and *gi*-infixation (55) (I will explain these terms in more detail after the examples).

(53) Màté **dù**-dùr-án-gò.
3pS **PVR**$_{PLRC}$-jump-PL-COMP
'They jumped repeatedly.' [15]

[15]Recall, I will indicate pluractional markers with their specific type (PVR, C2, *gi*), subscripted with PLRC for what I hope will be maximum clarity. Infixes (as well as gemination) are shown in angle brackets.

(54) Màté ndá'<**'**>-an-gò.
3pS leave-<**C2**$_{PLRC}$ >-PL-COMP
'They left repeatedly.'

(55) Màté à<**gì**>l-án-gò-yí.
3pS <**gi**$_{PLRC}$ >carry-PL-COMP-ØO
'They carried it repeatedly.'

The above markers are listed roughly in order of productivity. Partial verbal reduplication (PVR) is highly productive while C2 gemination and *gi*-infixation are much less so, with these two strategies mostly in complementary morphological distribution.

PVR, so called because it involves reduplication of the initial CV of the verb stem, is a highly productive process of pluractionality, viable for most verbs (morphologically, that is – semantically it is almost certainly restricted). When the first vowel of the stem is long, the CV reduplicant shortens it. Using the verb classes as they are described in Schuh and Gimba 2004 (hereafter S&G 2004) and Gimba (2000), PVR is available for all class A1 and A2 verbs and for at least transitive Class B verbs. It is available only for select Class C and D verbs. It is not clear to me what precisely governs what verbs allow PVR morphologically.

C2Gem is far more morphologically restricted than PVR, occurring on only some of the verbs of classes A1, B, C and D. It is achieved by geminating the second consonant of the verbal root, hence the name. If there is no second consonant – since some verbal roots consist of a single consonant – then the pluractional marker will be a geminate glottal stop, as we saw in (54). C2 and PVR are the markers focused on in the data and analysis shown below.

To satisfy curiosity about what is possible, though, here are the facts on *gi*-infixation: it is the most restricted of the basic pluractional markers, occurring only on a restricted subset of A1 and B verb types. Its name is totally transparent; it is formed by infixing the syllable *-gi-* after the first syllable. As far as data from S&G 2004 and Gimba 2000 indicate, this marker is almost in complementary distribution with C2Gem, and might in

fact be an allomorph of some kind. Future work includes investigating if the semantics of *gi*-infixation is identical to that of C2Gem, which would provide strong evidence for the allomorph hypothesis.

Bole also allows for a phenomenon called stacking. Stacking is when there are two pluractional markers on a verb stem at the same time. It is unlikely that all three strategies can occur at once since C2 and *gi*-infixation do not tend to work on the same stems. As far as I can tell, there is no morphological restriction on stacking, though; if a stem allows two pluractional strategies, then it allows them to stack. In (56) there is PVR and C2 stacking, and in (57) there is PVR and *gi* stacking.

(56) Màté ndá-ndá'<'>-an-gò.
3pS PVR$_{PLCR}$-leave<C2$_{PLRC}$ >-PL-COMP
'They left repeatedly.'

(57) Màté ngò-ngò<gì>r-án-náŋ-gó.
3pS PVR$_{PLRC}$-tie<gi$_{PLRC}$ >-PL-1sO-COMP
'They each tied me.' (Gimba 2000:163)

For the duration of this section, when I refer to stacking I will mean the type seen in (56), i.e. PVR with C2, as these markers have been the focus of my elicitations.

In *Bole Verb Morphology* Gimba defines pluractionals as involving "any of the combination of factors...below: one subject repeatedly doing the same action, one subject repeatedly doing the same action to the same object, one subject acting iteratively on several objects, several subjects acting one by one, several subjects acting iteratively on the same object, several subjects acting iteratively on several objects" (p. 142-3).[16]

[16]Gimba 2000 contains some specific description of each of the three pluractional strategies, but I have found that my new data and his generalizations do not agree, so I will not include them here. See Gimba 2000 for his account of some of the generalizations as to what licenses pluractionals.

What follows will be a departure from much of the discussion above. Large portions of the earlier focus was on how aktionsart class distinctions influence the interpretation of a pluractional. The data I have gathered on PVR, C2, and stacking are almost exclusively restricted to accomplishments. In short, the data set that I am working with is incomplete, and expanding this is certainly an area for future research. I continue next with an overview of some novel data on Bole pluractionals, and then continue with an analysis of PVR based on the analyses given above.

5.1 New Bole Data

As mentioned above, most of my eliciting was limited to the accomplishment aktionsart class. I varied parameters of the subject, object, and event arguments as follows. Subjects were either singular, distributive plural, or collective plural, where distributive and collective have their standard meanings. The event was described as occuring once or more than once (no multiple event scenario specified that the action was done exactly twice, so I don't know if two is a viable number of repetitions for Bole pluractionality to be licensed). There were many different choices of direct object (for transitive verbs only): a single object acted on once by each subject, a single object acted on more than once by each subject, a plurality of objects where each is acted on separately by the subject, a single plurality of objects where they are acted on as a group by the subject, or a plurality of pluralities of objects where each group is acted on as a unit by the subject. As this is a lot to process at once, I will be including an as-unambiguous-as-I-can-think-of English translation with each example sentence. In this section I aim to give an overview of the generalizations of PVR and C2 pluractionality for accomplishments in Bole and discuss general semantic phenomena that may influence the distribution and use of Bole pluractionality.

5.2 Pluractional Requirements in General

There is a clear multiple-event requirement for Bole accomplishments of the PVR, C2, and stacked varieties when there is a singular subject. A durative reading for a single event is not sufficient to allow a pluractional interpretation. In fact, duration makes no difference to the grammaticality of a pluractional in Bole, as the next examples show:

(58) Sam got very sick and died suddenly.

a. *Sam mómótu-wò.

b. *Sam móttu-wò.

c. *Sam mómóttu-wò.

(59) Sam has been sick and dying for a long time. Eventually he dies.

a. *Sam mómótu-wò.

b. *Sam móttu-wò.

c. *Sam mómóttu-wò.

Regardless of the duration of the event, a pluractional is ungrammatical here because there is a single *dying* event. Similarly, all of the following scenarios are not compatible with a pluractional verb because they are composed of a single event:

(60) a. Laura slaughtered a goat.

b. Bryon unties all of his many goats with only one motion.

c. Lee left at midnight.

So, for example, the three following sentences are possible pluractionals in Bole, but none may be uttered truthfully in the scenario in (60a):

(61) a. Laura kà-kàr-ák ỳshi.
laura PVR$_{PLRC}$-slaughter-3sf.COMP goat.p

b. Laura kà<r>r-ák ỳshi.
laura slaughter-<C2$_{PLRC}$>-3sf.COMP goat.p

c. Laura kà-kà<r>r-ák ỳshi.
laura PVR$_{PLRC}$-slaughter-<C2$_{PLRC}$>-3sf.COMP goat.p
'Laura slaughtered goats'

All FALSE if there is a single event of Laura slaughtering all of her goats.

In order for the proposition denoted by a sentence with a plural subject to be true, there must also be multiple events, with one exception. First, a standard example of the multiple event requirement:

(62) a. Màté bù-bùl-án gùusho.
3pS PVR$_{PLRC}$-dig.up-PL.COMP stone

b. Màté bù<l>l-án gùusho.
3pS dig.up-<C2$_{PLRC}$>-PL.COMP stone

c. Màté bù-bù<l>l-án gùusho.
3pS PVR$_{PLRC}$-dig.up-<C2$_{PLRC}$>-PL.COMP stone
'They dig up stones'

All FALSE if there is a single event of the people working together to dig up a single stone once; (62a) is TRUE if the group works together to dig up the same stone more than once, say if it has been reburied.

There is an exception to this rule, though. Some intransitive verbs allow C2 pluractionality when there is a single collective action while others do not. So, take the following scenarios:

(63) a. Shelley and her friends are walking in a group, so I see them all pass together at once.

b. At ten, Lee and his friends all left the party as a group.

Each of these scenarios make the proposition denoted by a sentence with a pluractional true:

(64) a. Màté gà-<ɗ>-ɗ-án-gò.
3pS pass.by-<C2$_{PLRC}$>-PL-COMP
'They walked by$_{(plurac)}$.'

True if the group walks by once or more than once.

b. Màté pà-<t>-t-án-gò.
3pS leave-<C2$_{PLRC}$>-PL-COMP
'They left$_{(plurac)}$.'

True if the group left once or more than once.

One might want to claim that is impossible to leave or walk by as a group; each individual must complete the action as well, and therefore there are actually multiple events, and a pluractional is licensed. However, this argument would seem to imply that for all intransitives where the action can be done individually, C2 pluractionality should be licensed with a collective subject. This is not the case, as (65b) shows. The following scenario cannot be paired with a C2 pluractional (or any other pluractional for that matter) grammatically:

(65) a. Damon and his friends are holding hands skating, and when the group skated over the slippery spot, they fell together.

b. *Màté sò-<t>-t-án-gò.
3pS fall-<C2$_{PLRC}$>-PL-COMP
Intended meaning: 'They fell$_{(plurac)}$.'

If an argument can be made that individuals cannot leave or walk by as a group without doing so distributively, then the same should be true of falling, but the verbs behave differently. Therefore something deeper is going on with C2 pluractionals and a collective intransitive subject. A first idea is that there is an unergative/unaccusative distinction at play, but the data is messy because of morphological blocking and argument structure ambiguity. Still, I think that this is an idea worth pursuing, and future elicitations will be aimed at discovering if this is the distinction we are observing in the data above.

Getting back to the main generalizations, clear cut cases of multiple events almost always allow for a pluractional sentence to be uttered. The following examples are indicative of the sorts of scenarios that make an appropriate pluractional proposition true:

(66) a. Bryon unties his dog from one thing, and then it gets tangled on another. He unties it again, over and over.

b. Shelley keeps going back and forth from her house to work so I see her pass by many times.

c. Marc digs up a stone. His dog likes to bury things though and keeps reburying the stone, and so Marc has to dig it up again and again.

d. Laura is preparing for a feast and slaughters each of her goats.

The following is a simple PVR example:

(67) a. Màté bù-bùl-an gusshe.
3pS PVR$_{PLRC}$-dig.up-PL.COMP stone.p
Scenario: Marc and his friends go out and spend the day clearing stones, each person digging up one stone at a time and digging up many stones.

If we are interested only in a very coarse level of granularity, then what we have covered so far counts for the basic generalizations of Bole pluractionality. However, it would be more

interesting to know how each pluractional marker in Bole is different. In the next section, I will outline what facts we can glean about PVR specifically and provide an analysis for PVR. I will save the data on C2 for Section 7, in keeping with the typological distinction between standard and nonstandard pluractional strategies.

5.3 Bole's PVR

PVR is by far the most permissive type of pluractionality. In the end, my main data set had forty-three scenarios that made a proposition with a pluractional true. Of these, twenty-nine use PVR, seven use C2Gem, and seven use stacking. This leads me to believe that PVR is a more general pluractional marker, and C2 and stacking are more specialized pluractionals. Put simply, it seems as though PVR is possible whenever there is a plural event; there are no further restrictions. Here are a few examples of PVR pluractionals:

(68) Bryon has many dogs tied up. He and a group of friends each untie a different dog.

a. Màté bì-bìɗ-án àdinse.
3pS PVR$_{PLRC}$-untie-PL.COMP dog.p

(69) Scenario: Lee and his friends each leave at a different time. Over the course of the night, individuals keep returning to the party and leaving again.

a. Màté pà-pàt-án-gò.
3plS PVR$_{PLRC}$-leave-PL-COMP

Given the discussion above of Karitiana, Kaqchikel's PLRC, and Chechen, the logical form of (69) is not going to be complicated, and the logical form of (68) would be the same with the addition with a theme argument. Extending the analysis of Karitiana, the following is the denotation of the intransitive verb phrase *pà-pàt-án*:

(70) a. $[\![\text{pàta}]\!] = \lambda x \lambda e. * pata(e) \wedge \text{AG}(e, x)$

b. $[\![PLRC]\!]([\![pata]\!]) = \lambda x \lambda e. *pata(e) \wedge \text{AG}(e, x) \wedge \neg\textbf{atom}(e)$

Assuming that *Lee, Henry, Kah*, and *Tony* are the agents of the leaving events, after function application and existential closure, the following will be the logical form of *Màté pà-pàt-án-gò* after existential closure:

(71) $[\![PLRC]\!]([\![pata]\!]([\![l \oplus h \oplus k \oplus t]\!])) = \exists e. *pata(e) \wedge \text{AG}(e, l \oplus h \oplus k \oplus t) \wedge \neg\textbf{atom}(e)$

This concludes the discussion of standard pluractional strategies. As we've seen for all of the above, the main requirement that the pluractional imposes on the logical form is that there be multiple events. As I will show in the next two sections, pluractionals can add more to the logical form, for example distributivity or collectivity requirements. In the next section, I will outline a dynamic approach to Kaqchikel's distributive pluractional marker, and then I will end the paper with a discussion of Bole's C2 collective pluractional marker, showing both a dynamic and static analysis for C2 pluractionals.

6 Non-Canonical Pluractionality 1: Kaqchikel's PDIST

In addition to the group denoting pluractional mentioned above, Kaqchikel has a pluractional (PDIST) that requires that the object of each atomic event is an atomic individual, never a group or plurality; that is, PDIST forces a distributive pluractional reading. Let's start with some examples, and then move to the formal tools necessary for an analysis. The following is an example of PDIST in action with a plural object:

(72) X-e-in-tun-ula ri qul.
CP-A3p-E1s-fold-PDIST the blanket
'I folded the blankets individually.'

FALSE if I folded any subset of the blankets simultaneously

When these distributive pluractionals do not have a plural theme to distribute over, they distribute over times or locations instead. If there is a singular blanket instead of the plural used in (72), the following occurs:

(73) X-in-tun-ula ri (jun) qul.
CP-E1s-fold-PDIST the (one) blanket
'I folded the blanket various times.'

For example, if every time you came into the room the kids had left the blanket out and you refolded it.

In order to account for PDIST, Henderson uses dependence logic and the concept of discourse plurality. He pursues this dynamic approach because of the interaction between the pluractional marker and indefinites. If there is a plain indefinite as the object of the pluractional, it obligatorily scopes high (74), that is, the object cannot covary with the events. If there is what is called a dependent indefinite as the object of a pluractional, it has obligatorily low scope (75).

(74) X-in-kan-ala' jun wuj.
CP-E1s-search-PLRC a book
'I looked for a book (various times).' (Henderson 2011)

FALSE if there is only one looking-for event; also FALSE if I am looking for different books every time.

(75) X-in-kan-ala' ju-jun wuj.
CP-E1s-search-PLRC a-a book
'I looked for some books one by one.' (Henderson 2011)

FALSE if there is only one looking-for event; also FALSE if I look for the same book in each looking-for event.[17]

[17]The reduplication of the numeral indicates that it is a dependent indefinite.

This contrasts with the behavior of indefinites and dependent indefinites under the scope of quantifiers, where a regular indefinite can now scope low, just like a dependent indefinite; it can also scope high, which a dependent indefinite still cannot do.

(76) K-onojel x-ki-kan-oj jun wuj.
E3p-all CP-E3p-search-SS a book
'All of them looked for a (different) book.' (Henderson 2011)

TRUE if there is one book that everyone looks for; also TRUE if each person looked for a different book.

(77) K-onojel x-ki-kan-oj ju-jun wuj.
E3p-all CP-E3p-search-SS a-a book
'All of them looked for a different book.' (Henderson 2011)

FALSE if they all looked for the same book; TRUE if each person looks for a different book.

In order to capture the differences between dependent indefinites and plain indefinites Henderson claims that pluractionality licenses dependent indefinites by constraining theta roles in a scopeless manner, i.e. by the theta dependency I will introduce below. As the goal of this paper is to account only for the pluractional data, I will leave out the analysis of dependent indefinites. Please see Henderson 2011 for the most recent analysis of this phenomenon.

While Kaqchikel provides a definitive reason for pursuing a semantic analysis in a dynamic framework, Bole does not provide evidence for preferring either a static or dynamic approach. Therefore, in the ensuing analysis of Bole's C2 pluractional, I will provide both a static and a dynamic analysis. In the next section, I will introduce much of the formalism necessary to understand the analysis that immediately follows. The rest of the formalism has been relegated to Section A, in the appendix.

6.1 Formalism

The syntax of dependence logic follows a standard format: there are constants and variables which are terms (a, b, c and x, y, z respectively), and any function f on terms is also a term; there are formulas of two types – if R is an n-ary relation and $t_1...t_n$ are terms, then $Rt_1...t_n$ is an atomic formula, and if $t_1...t_n$ are terms, then $\equiv (t_1...t_n)$ is an atomic formula; arbitrary formulas are defined as usual ($\neg, \wedge, \vee, \forall, \exists$). The only thing here that may be unfamiliar is $\equiv (t_1...t_n)$. It is called an atomic dependence formula, and it means that there is a function between the terms of the formula when looking across assignment functions.

This is the major difference between the logic presented here (FOD) and First Order Logic (FOL). FOD requires that formulas are interpreted relative to sets of assignments, e.g. G, whereas FOL is interpreted relative to a single variable assignment g. An assignment g is a total function from $\mathcal{VAR}$ to D, the domain of individuals. We are interpreting with respect to sets of sets of assignments, so FOD operates within $\wp(\wp(G))$, G being the space of assignment functions. These sets of assignments can be represented by matrices:

(78)

H	...	x	y	...
h_1	...	$entity_1$	$entity_4$	...
h_2	...	$entity_2$	$entity_4$	...
h_3	...	$entity_3$	$entity_4$	...
...	...	...	...	...

To get a feeling for what it means for $\equiv (t_1...t_n)$, let's look at a small example: $\equiv (x, y)$. This formula is true in (79), but false in (80).

(79)

	x	y
g	a	b
g'	c	b

(80)

	x	y
g	a	b
g'	a	c

(79) is true even though there are multiple things mapping to b. This is because $\equiv (x, y)$ is a function, but does not need to be 1-to-1. As such, different entities in x can map to the same entity in y, but the opposite is not true. As I will show later, this is important linguistically in a case where each event needs to have its own individual, but individuals can can take part in more than on event. A formal definition of the semantics of this function is as follows:

(81) $[\![\equiv (t_1...t_n)]\!] = \{G$: for all $g, g' \in G$, if $g(t_1) = g'(t_1)...g(t_{n-1}) = g'(t_{n-1})$, then $g(t_n) = g'(t_n)\}$

A special case of (81) is $\equiv (x)$, which is true if and only if all assignment functions happen to assign the same individual to x, that is, it is discourse singular (this will be important later).

It is also necessary to define the syntax-semantics interface. A neo-Davidsonian approach to theta roles will be taken: theta roles are independent arguments of events conjoined to the main predicate, as in the following:

(82) $R(e) \wedge \textsc{Agent}(e, a) \wedge \textsc{Theme}(e, b)$

In (82), a is the unique agent of e, b the unique theme.[18] To translate this idea into FOD, as seen in (83), the individual must still behave as the appropriate theta role (θ) in a given

[18]If a theta role is occupied by a conjunction or disjunction, that theta role would need to be represented by a sum or other complex semantic object instead of a single unique constant or function.

event. Below, x is the θ theta role in e; in an actual formula, the theta role would be specified as agent, theme, or whatever it may be. Secondly, if for any two assignments g, g' in a set of assignments G, when they agree on e they must also agree on x, then the dependency is true with respect to that G.

(83) $\theta(e, x) \wedge \equiv (e, x)$, abbreviated $\overset{\theta}{\equiv} (e, x)$

In order to fully account for PDIST, Henderson defines two notions of cardinality in FOD for two kinds of plurals: *domain plurals* and *discourse plurals*. The former is a plural individual, and can be evaluated within a single cell of the matrices shown above, whereas the latter is a variable that gets a plurality of values across a set of assignments, and can be evaluated by looking down a column of the matrix. Henderson makes this distinction to account for the fact that in a given event the participant to be atomic in one sense, that is by being literally 'one ant' or 'one child,' but it is also plural since there are many such 'one ant' or 'one child' participants. This will become clearer after I've defined the concepts.

Domain plurality is defined as follows, where an individual is an atom if it has cardinality one and is a non-atom otherwise.

(84) a. $[\![\mathbf{atom}(x)]\!] = \{G : |g(x)| = 1 \text{ for all } g \in G\}$

b. $[\![\neg\mathbf{atom}(x)]\!] = \{G : |g(x)| \neq 1 \text{ for all } g \in G\}$ (definition not from Henderson, added to further parallel the following definitions)

c. $[\![\mathbf{three}(x)]\!] = \{G : |g(x)| = 3 \text{ for all } g \in G\}$

d. $[\![\mathbf{many}(x)]\!] = \{G : |g(x)| > n \text{ for all } g \in G\}$

To define discourse plurals, we need the following definition. It defines the set of images of x under all of the g's in G.

(85) $G(x) := \{g(x) : \text{for all } g \in G\}$

In defining discourse plurals (columns) instead of mereological plurals (individual cells), a different notation is used to avoid confusion. Being discourse atomic is the same as being a constant function: every assignment assigns the same value to x. The negation of atomicity allows us to pick out discourse plurals.

(86) a. $[\![\equiv (x)]\!] = [\![x \equiv 1]\!] = \{G : |G(x)| = 1\}$

b. $[\![\neg \equiv (x)]\!] = [\![x \geq 2]\!] = \{G : |G(x)| > 1\}$

c. $[\![x \equiv 3]\!] = \{G : |G(x)| = 3\}$

d. $[\![x > n]\!] = \{G : |G(x)| > n\}$

To show the distinction between the two types of pluralities, consider the following: *one* ϕ and *two* ϕ. They both claim that there is a particular individual, either of cardinality one or two, that is part of ϕ. That is, we have a difference in domain plurality but both are discourse singular. Here is how the two formulas look:

(87) a. one $\phi \rightsquigarrow \exists x(x \equiv 1 \wedge \mathbf{one}(x) \wedge \phi(x))$

b. two $\phi \rightsquigarrow \exists x(x \equiv 1 \wedge \mathbf{two}(x) \wedge \phi(x))$

Now that FOD has been defined, these tools can be used to analyze distributive pluractionality. What follows for Kaqchikel will act as an outline for the later analysis of collectivity in Bole.

6.2 Analysis

For the analysis, first define an operator $\mathbf{Max}^x$. This operator is necessary because Henderson defines PDIST as adding a clause to the logical form which takes the maximal set of event and individual atoms and relates them via a theta dependency. This enables the distributive reading necessary for PDIST. **Max** picks out and stores in a variable the maximal

set of entities that satisfy whatever it is applied to, as follows:

(88) $[\![\mathbf{Max}^x(\phi)]\!] = \{G : G \in [\![\phi]\!]$ and all G' are such that if $G' \in [\![\phi]\!]$ then $G'(x) \subseteq G(x)\}$

Combined with cardinality requirements and theta dependencies, all pieces necessary for the meaning of PDIST, we arrive at the following definition of PDIST (89), broken down into its component parts in (89a)-(89d) to make the discussion clearer:

(89) $[\![PLRC]\!]([\![V]\!]) = \lambda x \lambda e.\, [V(e) \wedge \overset{th}{\equiv} (e, x) \wedge \exists e' \exists x' [\mathbf{Max}^{\{e', x'\}}(e' > n \wedge e' \leq e \wedge x' \leq x \wedge \mathbf{atom}(e') \wedge \mathbf{atom}(x')) \wedge \overset{th}{\equiv} (e', x')]]$

a. $V(e) \wedge \overset{th}{\equiv} (e, x)$

b. $\exists e' \exists x' [\mathbf{Max}^{\{e', x'\}}$

c. $(e' > n \wedge e' \leq e \wedge x' \leq x \wedge \mathbf{atom}(e') \wedge \mathbf{atom}(x'))$

d. $\overset{th}{\equiv} (e', x')]$

The conjuncts contributed by (89a) are those contributed by the verb. The meaning of the pluractional itself starts in (89b) which introduces variables for events and individuals (e' and x' respectively), and then by **Max**, stores the maximal subsets of all of the atomic individuals and events that satisfy (89c) in those variables. (89c) restricts the events and individuals stored by **Max** to those that are atomic subevents or individuals of the main event and theme. (89c) also adds the contextual standard n above which the cardinality of e' must be. Notice that this is a discourse plurality, using the definition in (86d), whereas the conjunct '$\wedge \mathbf{atom}(e')$' ensures that it is domain singular. (89d) introduces a theta dependency between the stored maximal sets of atomic events and individuals.

Let's consider the following examples, contrasting a simple sentence to one with PDIST to see how it works:

(90) X-e'-in-q'etej oxi' ak'wal-a'.
CP-A3p-E1s-hug three child-PL
'I hugged three children.'

(91) X-e-in-qete-**la** oxi akwal-a.
CP-A3p-E1s-hug-**PDIST** three child-PL
'I hugged three children individually (many times).'

(92)[19] gives the denotation of the sentence in (90) and (93) gives an example of a assignments satisfying (92).

(92) $\exists e[e \equiv 1 \wedge *\textsc{hug}(e) \wedge \overset{ag}{\equiv} (e, Sp) \wedge \exists x[x \equiv 1 \wedge *\textsc{child}(x) \wedge \mathbf{three}(x) \wedge \overset{th}{\equiv} (e, x)]]$

(93)

H	...	e	x
h_1	...	hug_7	$three.children_4$
h_2	...	hug_7	$three.children_4$
h_3	...	hug_7	$three.children_4$

Both x and e are discourse singular, and x is a domain plural individual, that is, three children. e and x stand in the theme relation to each other, with function possible between them.

Now, let's do the same for (91), where (94) gives the denotation of the sentence and (95) gives an example of satisfactory assignment functions. Notice that the only difference is the addition of the denotation of PDIST.

(94) $\exists e[e \equiv 1 \wedge *\textsc{hug}(e) \wedge \overset{ag}{\equiv} (e, Sp) \wedge \exists x[x \equiv 1 \wedge *\textsc{child}(x) \wedge \mathbf{three}(x) \wedge \overset{th}{\equiv} (e, x)$
$\wedge \exists e' \exists x'[\mathbf{Max}^{\{e', x'\}}(e' > n \wedge e' \leq e \wedge x' \leq x \wedge \mathbf{atom}(e') \wedge \mathbf{atom}(x')) \wedge \overset{th}{\equiv} (e', x')]]]$

[19]The logical form in (92) is taken straight from Henderson, as is the non-pluractional part of (91).

(95)

H	...	e	x	e'	x'
h_1	...	hug_7	$three.children_4$	hug_1	$child_2$
h_2	...	hug_7	$three.children_4$	hug_2	$child_3$
h_3	...	hug_7	$three.children_4$	hug_3	$child_9$
h_4	...	hug_7	$three.children_4$	hug_4	$child_3$
h_5	...	hug_7	$three.children_4$	hug_5	$child_2$
h_6	...	hug_7	$three.children_4$	hug_6	$child_9$
...	...	...	...	...	...

Here, the hugging event hug_7, is broken down into its atomic hugs in e'. There need to be more than n such huggings in e', each of which has an atomic child as its theme. Notice that there are only three children, but more than three atomic hugs. This is permitted because $\overset{th}{\equiv}(e', x')$ is a function from e' to x' but not vice versa. This also allows PDIST to take singular themes, as was shown at the beginning of this section.

This concludes the discussion of distributivity on Kaqchikel and leads us finally on to our discussion of Bole's C2 pluractional. The concepts introduced so far in this paper will shape the analysis of C2. First I will present the data for C2 and discuss exceptions that require the definition of C2 collectivity to be quite narrow. Following the data discussion, I will present two analyses of C2, one based on Henderson 2010, 2011, and the other a static approach to C2 collectivity. When providing the static approach to C2 I will also provide a static approach to Kaqchikel's PDIST for the sake of comparison.

7 Non-Canonical Pluractionality 2: Bole's C2

I end the analysis portion of the paper with more data from Bole, namely on the C2 pluractional mentioned in Section 5. First, let me reiterate an earlier disclaimer in more detail.

The elicitation was presented as follows: I gave a scenario and then asked if a sentence with a PVR pluractional could be uttered truthfully to describe the scenario. I then asked if a C2 pluractional sentence was licensed, and finally if a stacking sentence was licensed. The task was a written survey, so all three were visible at the same time. I realize now that this was not the best way to do the elicitations because I believe it led my consultant to pick favorites rather than pick all possible options. The fact that there were only two scenarios in which more than one of the three pluractional strategies was selected, and that the two were for different verbs in non-parallel scenarios, indicates that there could be a problem with the methodology. Given that, we can focus on when C2 is preferred, keeping in mind that PVR might also be licit in these situations. Moreover, even in asserting that what C2 prefers, I am relying on limited data. All assertions will be checked and reanalyzed in future fieldwork.

With all of the disclaimers out of the way, I will show the generalization for C2. Five of the seven examples occur when the scenario is described with a collective subject, which leads me to believe that when there is a plural subject, C2 generally must receive a collective interpretation. I will give an analysis of this interpretation in the next section, and the explanation of the two exceptions will follow the successful example. The following is an example of a C2 pluractional with a collectively interpreted subject:

(96) Màté bì-ɗ<ɗ>-án àdinse.
3pS untie-<C2$_{PLRC}$ >PL.COMP dog.p
Scenario: Bryons knots are so complex that he needs help from his friends to undo each. He, Matt, Maria, and some others work together to untie many dogs one at a time.

This sentence may not be uttered to truthfully describe a scenario where each person unties different dogs, or one in which each person takes a turn untying all of the dogs; the action

indicated by the verb must be completed as a group. The same is true of the other four successful C2 pluractional examples.

The outliers that were compatible with C2 include a transitive with a singular subject (97) and a distributive subject of an intransitive verb(99). Both of these use C2, and neither has a collective subject. Let's start with the singular subject case.

(97) Marc bùl-<l>-áa gusshe.
marc dig.up-<C2$_{PLRC}$>3sm.COMP stone.p
Scenario: Marc spent all day digging up stones.

This example is not a true exception to the rule that I set out, as my claim is a conditional: if there is a plural subject, then it must be a collective subject. This does leave open the question of what happens to singular subjects. I do not have enough data on the matter to give any useful generalization. This is not a unique example, though. The following is another example of C2 with a singular subject (data from Russell Schuh p.c.):

(98) Ka ɗolliti yakko siɗok-siɗok.
'You (male singular) may swallow as you wish *gulp-gulp.*'

Leaving singular subjects as a matter for later attention, the only remaining outlier in my data set was the following:

(99) Màté gàɗ-<ɗ>-án-gò.
3pS pass.by-<C2$_{PLRC}$>PL-COMP
Scenario: Shelley has a lot of friends visiting her at work, and I see her pass and then see her friends pass by one by one throughout the day.

This sentence, a C2 intransitive with a distributive subject, is another example of a trend that

I began discussing earlier. It appears as though intransitive verbs in Bole do not follow clear cut patterns with respect to pluractionality (recall (64),(65)). The following is another data point that shows the incongruities of intransitive pluractionals in Bole (data from Russell Schuh, p.c.):

(100) Maine ya mottan ye, Allah yapesu.
'Those who have died, may Allah forgive them.'
This example is in reference to a number of people that have died at different times and places.

Clearly, this subject cannot be interpreted collectively. Therefore, there is much more to be explored in order to discover why some intransitives follow the pattern of requiring a collective subject while others do not. This distinction is beyond the scope of this project and is an area of further study. In the next section, I will use C2 intransitives with collective subjects for some of my examples, but keep in mind that not all intransitives behave properly.

In this section, I've covered some of the generalizations of the semantic licensing of the C2 pluractional in Bole. While tentative, it is a starting point for elicitations on many more topics. In the next section I will gloss over any wrinkles in the data and propose an analysis for C2 assuming that it is licensed with collective subjects. The discussion of C2 will focus on on the collective/distributive distinctions between Kaqchikel and Bole, and both static and dynamic accounts will be given.

7.1 Collectivity in Bole Pluractionality

I claim in this section that C2 requires a collective subject. The following minimal pairs illustrate the basic difference between PVR and C2. First, here is an example with a transitive verb (partially repeating (68)):

(101) Scenario: Bryon has many dogs tied up. He and a group of friends each untie a different dog.

a. Màté bì-bìɗ-án àdinse.
3pS PVR$_{PLRC}$-untie-PL.COMP dog.p

b. *Màté bì-ɗ<ɗ>-án àdinse.
3pS untie-<C2$_{PLRC}$ >PL.COMP dog.p

(102) Scenario: Bryons knots are so complex that he needs help from his friends to undo each. He, Matt, Maria, and some others work together to untie many dogs one at a time.

a. *Màté bì-bìɗ-án àdinse.
3pS PVR$_{PLRC}$-untie-PL.COMP dog.p

b. Màté bì-ɗ<ɗ>-án àdinse.
3pS untie-<C2$_{PLRC}$ >PL.COMP dog.p

A parallel example using an intransitive verb is as follows (partially repeating (69)):

(103) Scenario: Lee and his friends each leave at a different time. Over the course of the night, individuals keep returning to the party and leaving again.

a. Màté pà-pàt-án-gò.
3plS PVR$_{PLRC}$-leave-PL-COMP

b. *Màté pà-<t>-t-án-gò
3plS leave-<C2$_{PLRC}$ >-PL-COMP

(104) Scenario: Lee and his friends all leave together. Over the course of the night, they, as a group, keep returning to the party and leaving again.

a. *Màté pà-pàt-án-gò.
3plS PVR$_{PLRC}$-leave-PL-COMP

b. Màté pà-<t>-t-án-gò
3plS leave-<C2$_{PLRC}$ >-PL-COMP

As I've already analyzed PVR, I will discuss only Bole's second pluractional marker, C2. This is unlike any shown so far in that it requires a collective subject. In both Bole and Kaqchikel, a distinction can be made between a canonical, or general, pluractional and a non-canonical, or special pluractional marker. The general marker is more permissive of which scenarios allow for a truthful utterance of a pluractional sentence. The special marker has very specific requirements; for Kaqchikel it needs the object to be interpreted distributively while for Bole it requires that the subject be interpreted collectively. This is not to say that the denotations of the special markers are necessarily more complex than the general ones; there is simply a distinction with respect to what breadth of scenarios is compatible with the general versus the specific markers.

Henderson's analysis, as is, wrongly predicts the lack of existence of a collective marker. The tools developed make a distributive pluractional possible, namely via the theta dependency ($\overset{\theta}{\equiv}(e, x)$). Recall, distributivity is enforced by ensuring that every atomic event has exactly one atomic participant as its object. However, there is no special account for collectivity.

Several possibilities leap to mind for an analysis of the collective subject meaning in Bole. One option is to account for collectivity by negating distributivity (similar to Schwarzschild 1994). In this case, that would mean in some way negating the definition for distributivity that was shown above for Kaqchikel. Another possibility is to provide a new and separate collective operator, say a C-Op. A third option is to use tools we already have that are not specifically for either collectivity or distributivity to create a collective requirement.

I believe that the data can be accounted for in any of ways discussed above, but the analysis that I ultimately decide on is one without a distributivity or collectivity operator. I will provide both a static and dynamic account of my analysis, the former based somewhat on the formalism to be found in Schein 1993 and the latter based on Henderson 2010, 2011.

I choose this route for several reasons. First, there is no evidence that Bole pluractionality employs a D operator. Therefore, it seems circular to posit a distributivity operator just so that it can be negated to allow a collective meaning. Similarly, there is not much evidence cross-linguistically for the necessity of a collectivity operator. Therefore, if collectivity can be accounted for without a C-op, then this is an appealing option as it does not rely on a rarely attested linguistic object.

In the rest of this section, I will give a static analysis of Bole and then present a static analysis of the Kaqchikel's PDIST for easy comparison. In order to round out the comparison, I will then review Henderson's dynamic distributive analysis, and then show a dynamic approach to Bole's C2 pluractional.

7.1.1 Static Analyses

First, as was shown in previous sections, C2 pluractionals do not have a multiple event requirement. Therefore, there is no clause like '$\neg\mathbf{atom}_{\leq}(e)$, even though this has been present in all previous pluractional logical forms. For the sentence given above in (104), there happen to be multiple events, but remember the following data, repeated from (63) and its pluractional form in (64).

(105) a. Shelley and her friends are walking in a group, so I see them all pass together at once.

b. At ten, Lee and his friends all left the party as a group once.

Each of these scenarios can be described grammatically with a C2 pluractional sentence:

(106) a. Màté gà-<ɗ>-ɗ-án-gò.
3plS pass.by-<C2$_{PLRC}$ >-PL-COMP
'They walked by$_{(plurac)}$.'

b. Màté pà-<t>-t-án-gò.
3plS leave-<C2$_{PLRC}$>-PL-COMP
'They left$_{(plurac)}$.'

While it may not be clear how the subject of a intransitive like 'leave' can be interpreted collectively, I am going to present my analysis based on this intransitive to simplify the logical forms. Given what was shown in (102), it is clear that C2 transitives have a collectively interpreted subject. I am extending this conclusion to successful C2 intransitive pluractionals as well.

There are only two other requirements of C2. First, the subject of the sentence cannot be atomic. Second, each atomic subevent of the main event must have the same non-atomic subject as its has as its subject as well. The following logical form captures these requirements, basing the analysis loosely off of the ideas in Schein 1993.[20] Note that the pluractional meaning is combined with the verb meaning by predicate modification rather than function application:

(107) $[\![PLRC]\!]([\![V]\!]) = \lambda x \lambda e.\, \neg\mathbf{atom}(x) \wedge \forall e'[e' \leq e \wedge \mathbf{atom}(e') \rightarrow \textsc{ag}(e', x)]$

In English: The subject cannot be atomic, the verb must add its semantic content, and every atomic subevent of the main event e has this same nonatomic participant as its subject. The following is a full derivation of the analysis of the proposition in (106b). The scenario presented for (106b) had *Lee*, *Ryan*, and *Michael* as the collective subject *màté*, 'they.'

(108) a. $[\![leave]\!] = \lambda x \lambda e.\, leave(e) \wedge \textsc{ag}(e, x)$

[20]For Schein there are no plural entities; there are predicates which apply to singular objects which allow them to appear plural. It is beyond the scope of this paper to go into the details of that proposal, so I will gloss over that detail and use just the intuitions of Schein 1993 instead.

b. $[\![PLRC]\!]([\![leave]\!]) = \lambda x \lambda e.\, \neg\mathbf{atom}(x) \wedge \forall e'[e' \leq e \wedge \mathbf{atom}(e') \rightarrow \textsc{ag}(e', x)]$

c. $[\![PLRC]\!]([\![leave]\!]([\![l \oplus r \oplus m]\!])) = \lambda e.\, \neg\mathbf{atom}(l \oplus r \oplus m) \wedge leave(e) \wedge \textsc{ag}(e, l \oplus r \oplus m) \wedge \forall e'[e' \leq e \wedge \mathbf{atom}(e') \rightarrow \textsc{ag}(e', l \oplus r \oplus m)]$

d. $[\![$Màté pà-<t>-t-án$]\!] = \exists e.\, \neg\mathbf{atom}(l \oplus r \oplus m) \wedge leave(e) \wedge \textsc{ag}(e, l \oplus r \oplus m) \wedge \forall e'[e' \leq e \wedge \mathbf{atom}(e') \rightarrow \textsc{ag}(e', l \oplus r \oplus m)]$

Note that the move from (108c) to (108d) is made by assuming existential closure at the end of the derivation. What picks this out as a specially collective reading is that the main event and every subevent has as its subject the same nonatomic participant. In doing the logical form as I have, I've avoided issue of whether collectivity is or isn't the negation of a distributivity operator as well as the questions of whether or not the semantics needs a separate collectivity operator.

Now I will present a static approach for Kaqchikel's PDIST. Recall that PDIST requires that each atomic subevent of the main event has as its theme exactly one atomic subparticipant of the theme of the main event. If the theme is plural, a single individual will be picked out for each subevent and repetition on a particular object is not necessary; if the theme is singular then each subevent has the same atomic participant as its theme and there is a repeated event reading. The following is a possible denotation of the distributive pluractional intransitive VP in Kaqchikel:

(109) $[\![PDIST]\!]([\![V]\!]) = \lambda x \lambda e.\, \neg\mathbf{atom}(e) \wedge \underline{V(e) \wedge \textsc{th}(e, x)} \wedge \forall e'\, \exists! x'[e' \leq e \wedge \mathbf{atom}(e') \wedge x' \leq x \wedge \mathbf{atom}(x') \rightarrow \textsc{th}(e', x')]$

The denotation of the pluractional marker adds to the logical form first the requirement that the main event is non-atomic. Second, it requires that for all atomic subevents of the main event e there is exactly one ($\exists!$) atomic x' such that x' is part of the theme x and x' is the

theme of e'.[21] The underlined portion is the denotation of the verb without the pluractional. The main difference to note is the following: $\exists!x'[x' \leq x \wedge \mathbf{atom}(x')]$. These pieces of the logical form in (109) contribute the atomicity requirement of the pluractional's theme. In contrast, Bole's C2 requires that the same participant be non-atomic and agent to the main event and all subevents. This is the crucial difference between the static approaches given above. In the interests of comparing PDIST and C2 as completely as possible, in the next section I will give a brief dynamic analysis of C2 to compare to Henderson's proposal.

7.1.2 Dynamic Analyses

First, let's very quickly review Henderson's analysis of a PDIST, as my analysis of Bole will use his **Max** operator. The following sentence is a distributive pluractional in Kaqchikel, and the following formula is the contribution of the distributive pluractional morpheme.

(110) X-e'-in-q'ete-la' ri ak'wal-a'.
CP-A3p-E1s-hug-PLRC the child-PL
'I hugged the children individually.'

(111) $[\![PLRC]\!]([\![V]\!]) = \lambda x.\lambda e.\,[V(e) \wedge \overset{th}{\equiv}(e,x) \wedge \exists e'\exists x'[\mathbf{Max}^{\{e',x'\}}(e' > n \wedge e' \leq e \wedge x' \leq x \wedge \mathbf{atom}(e') \wedge \mathbf{atom}(x')) \wedge \overset{th}{\equiv}(e',x')]]$

Again, this affix adds to the logical form of the verb phrase the requirement that every atomic subevent of the main event has as its theme an atomic subparticipant of the theme of the main event. It does so by collecting the maximal sets of atomic subevents and atomic

[21] It is not clear from the data if every atomic part of the theme needs to have an event to be an object of, but if that is the case, then we can add the following conjunct, requiring that for each atomic participant there is at least one event that it is the theme of:

(i) $\wedge\forall x'\,\exists e'[x' \leq x \wedge \mathbf{atom}(x') \wedge e' \leq e \wedge \mathbf{atom}(e') \rightarrow \textsc{th}(e',x')]$

This would ensure that every atomic participant had an atomic event to participate in.

participants in e' and x' respectively and relating them via a theta dependency.

For Bole's collective pluractional C2, I use the **Max** operator to store the maximal set of atomic events across assignment functions. This operator collects all atomic subevents of the main event e because all subevents then enter into a theta dependency with the *same* nonatomic collective subject. This participant cannot be discourse plural; that is, the same (domain plural) participant is the agent of each atomic event. Putting it all together, we arrive at the following logical form:

(112) $[\![PLRC]\!]([\![V]\!]) = \lambda x \lambda e.\, [V(e) \wedge \overset{ag}{\equiv} (e, x) \wedge \exists e' [\mathbf{Max}^{\{e'\}}(e' \leq e \wedge \mathbf{atom}(e')) \wedge \overset{ag}{\equiv}(e', x) \wedge \neg \mathbf{atom}(x) \wedge x \equiv 1]]$

What makes this so special? As opposed to distributives, it does not allow atomic individuals to participate in atomic events. It is also more specific than the generic multiple event PVR or Karitiana pluractional. By making the subject nonatomic but discourse singular, we ensure that every subevent has the exact same subject, and that the subject behaves collectively, as desired. The following shows an example of a set of assignments that meets the criteria of a C2 pluractional:

(113)

H	...	x	e	e'
h_1	...	$màté_3$	$leave_9$	$leave_1$
h_2	...	$màté_3$	$leave_9$	$leave_2$
h_3	...	$màté_3$	$leave_9$	$leave_3$
h_4	...	$màté_3$	$leave_9$	$leave_4$
h_5	...	$màté_3$	$leave_9$	$leave_5$
h_6	...	$màté_3$	$leave_9$	$leave_6$
...	...	...	...	...

This concludes the comparison of C2 and PDIST. As I have shown, both pluractionals can be accounted for in either a static or dynamic approach, and while they may be on opposite ends of the distributive scale, no special distributivity operator is necessary. To close this section, I would like to present an intermediate distributive case. We've seen for Chechen that the same pluractional will have a durative or frequentative reading depending on what predicate it occurs with. There is a third possibility. Some predicates in Chechen have a distributive interpretation when the same pluractional marker is used:

(114) ceera∼ duezalsh takhana duqa hxaalkhie ghittira
their members-of-family today very early wake-up.PLR.WP
'Their family members work up very early.'

Speaker indicates that the use of the pluractional emphasizes the independence of the waking events.

The fact that Chechen has some distributive pluractionals, but not an entire pluractional marker devoted to the distributive reading, puts it somewhere in between Bole and Kaqchikel, with each of those on an extreme of the distributive scale. It is worth doing a cross linguistic study to see what other options are available for distributive pluractionality.

While this is a functional analysis for the data provided, in order to truly understand the semantics of PVR and C2, more data is necessary. A take home message, though, is that the collective reading does not necessarily have to be subsumed under the general pluractional of a language, as can be assumed for Kaqchikel and Chechen (and maybe Karitiana – there isn't enough data to say). In Bole, the collective is the special case. It will be worth looking at other pluractional languages to see how they address the collective/distributive distinction. This concludes both the discussion of Bole and the analysis of the parallels between the four

pluractional languages discussed. All that remains is to conclude, discuss implications of what we've seen, and mention some areas of further study.

8 Conclusion and Future Direction

The purpose of this paper has been threefold. First, I wanted to give a small typology of pluractional languages, comparing and contrasting canonical and non-canonical pluractional strategies. I took one perspective on the semantics of pluractionality and showed how it fared with new language data. I also wanted discuss the distributive/collective disparity in pluractional languages and analyze the collective marker of Bole. I gave an overview of Henderson 2010, especially illuminating the points that were relevant for Bole. What we found is that the basic ideas, that is, the two ordering relations and pluractionality being a non-atomicity requirement, hold up well for parts of not only Bole, but also Chechen, another pluractional language.

However, unlike Karitiana, this is not the whole story, and both languages required an extension of the Henderson semantics. The Chechen data indicated both that an expansion of the domain of pluractionality and a reinterpretation of the μ function (or something else like these) were necessary adaptations to capture the durative reading of the Chechen pluractional. Bole was rather the opposite of Kaqchikel in that it required a collective pluractional as a special form rather than a distributive pluractional. So, while Henderson 2010, as is, could not properly handle either Chechen or Bole, the changes necessary to explain the new data were mostly small in nature. Therefore, it is possible that Henderson 2010 is on the right track, and at the very least lays out a foundation that pluractionality in general can build on.

This brings up some more general questions. For example, is there a default setting for

each language for whether a plural argument is interpreted collectively or distributively? From just the limited data we have here, it seems that there cannot be a language independent universal since Bole and Kaqchikel vary on this parameter. However, there could be tendencies. Bole is the first language that I have encountered that might have a specific collective pluractional marker, while distributivity has been a fairly common reading. If it is true that distributivity is more common than collectivity, how should the semantics of pluractionality adapt to account for this difference?

Another concept of broader linguistic interest is the discussion on μ in the event domain. If there are indeed different ways that μ can be interpreted, just as there are for the individual domain, then we have found another parallel between domains. Researchers are always looking for these kinds of parallels under the impression that establishing them justifies the existence of the domains under discussion. Following that tradition, a new parallel between the event and degree domains is a step forward in defense of both. As I mentioned before, Nakanishi 2007 takes a similar stance in arguing that μ needs to be used in the event domain as well as the individual domain, further drawing the domains together. So while pluractionality is often studied due to its parallels to the individual domain, those working on it and other topics should keep their eyes open for opportunities to find still more parallels.

This study leads me to question of whether or not there can be a single, unified, definition for pluractionality. As we have seen, affixes that clearly mark pluractionality also mark distributivity, collectivity, durativity, and even allow for single event scenarios as long as other criteria are met. If multiple eventhood is not a set-in-stone requirement for pluractionality, then the field really opens up as to what qualifies. I do not want to take a stand on the matter, but instead would like to encourage others to join in the pluractional fray and see what facts other pluractional languages can contribute. Pluractionality is a field ripe with chances to discover more about event and argument structure, and as far as I can tell, there

has not been nearly enough fieldwork on the matter.

This naturally segues into the subject of opportunities for further fieldwork on Bole. Many of the goals I mean to pursue were outlined in the Bole section, but I will reiterate them here. So far, only one aktionsart class has been investigated pluractionally in Bole, so questions of what the domain of pluractionality is in Bole cannot be answered yet. Within the arena of accomplishments, I need to test more verbs and scenarios so that clearer patterns emerge; I also need to test the exceptional cases to see if there was consultant confusion. Given the work in Kaqchikel, it would make sense to see how distributive quantifiers interact with Bole pluractionals; I would predict that they are not possible with the C2 pluractional at all.

Outside of Bole, future direction for this project simply involves looking at more data. The four languages investigated in this paper all have different semantic analyses for their pluractionals, and having more languages will hopefully add understanding to the typology of pluractional meaning.

Appendices

A FOD Formalism

This appendix is meant to outline the definitions for FOD as they are presented in Henderson 2010. It is still an abbreviation, so for a full explanation please see the original. Some sections are repeated from the main text of the paper to maintain this as a cohesive whole. I'll start with the semantics of FOD, basing this off of the fact that denotations are determined with respect to sets of sets of assignments. First, we need the domain D of individuals, I the

interpretation function such that $I(R) \subseteq D^n$ for any n-ary relation R and $I(f) : D^n \to D$ for each n-ary function f, and finally our model $\mathcal{M} = \langle D, I \rangle$. An assignment g is a total function from $\mathcal{VAR}$ to D. Given that we are interpreting with respect to sets of sets of assignments, the FOD operates within $\wp(\wp(G))$, G being the space of assignment functions. Now, let's jump right into definitions for denotations:

(115) a. $[\![Rt_1...t_n]\!] = \{G : \text{any } g \in G \text{ is such that } \langle g/I(t_1)...g/i(t_n)\rangle \in I(R)\}$

b. $[\![\equiv (t_1...t_n)]\!] = \{G : \text{for all } g, g' \in G, \text{ if } g(t_1) = g'(t_1)...g(t_{n-1}) = g'(t_{n-1}), \text{ then } g(t_n) = g'(t_n)\}$

A special case of (115b) is $\equiv (x)$, which is true if and only if all assignment functions happen to assign the same individual to x, that is, it is discourse singular (this will be important later). On to more definitions:

(116) a. $[\![\phi \wedge \psi]\!] = \{G : G \in [\![\phi]\!] \text{ and } G \in [\![\psi]\!]\}$

b. $[\![\phi \vee \psi]\!] = \{G : G \in [\![\phi]\!] \text{ or } G \in [\![\psi]\!]\}$

Next, we need to be able to pointwise manipulate sets of assignment functions. Define $g[x]g'$ as g and g' differ at most with respect to x. Then we can define something analogous for sets of assignments:

(117) $G[x]G'$ iff the following two conditions hold:

a. for all $g \in G$ there is a $g' \in G'$ s.t. $g[x]g'$.

b. for all $g' \in G'$ there is a $g \in G$ s.t. $g[x]g'$.

This defines that sets of assignments vary only with respect to x if for every assignment in one set of assignments, there is an assignment in the other set that is completely identical to the first except for the individual assigned to x. And now we can define quantifiers:

(118) a. $[\![\exists x\phi]\!] = \{G : \text{there is a } G' \text{ such that } G[x]G' \text{ and } G' \in [\![\phi]\!]\}$

b. $[\![\forall x\phi]\!] = \{G : \text{all } G' \text{ satisfying } G[x]G' \text{ are such that } G' \in [\![\phi]\!]\}$

Fine, but what does that actually say? (118a) says that there exists an x that satisfies ϕ if there is a way that you can manipulate the assignment sets *only* at x and produce a true sentence. This is exactly like FOL. Basically, if you can find a set somewhere that leaves everything else alone but assigns the variable correctly, the formula is satisfied. The same is true for (118b), except this naturally says that all assignments which vary only at x need to be such that they make the formula true.

So far, we have independently defined things that could have been defined as the negation of other things. Negation is a problem because there is uniform way to negate all of the formulas that have been introduced. To deal with this problem, below are defined denotation and anti-denotations, and negation simply flips meanings from one to the other. This is done because specifically defined anti-denotations most naturally reflect natural language semantics. Sometimes we want to negate distributively (lexical relations) and sometimes we want to negate collectively (dependence formula) (for arguments as to why we want it this way, see Henderson 2010). Anti-denotations make this possible. To implement this, we need to define $[\![\phi]\!]^+$, which is equivalent to $[\![\phi]\!]$, as well as $[\![\phi]\!]^-$, the anti-denotation.

(119) a. $[\![Rt_1...t_n]\!]^+ = \{G : \text{any } g \in G \text{ is such that } \langle g/I(t_1)...g/i(t_n)\rangle \in I(R)\}$

b. $[\![Rt_1...t_n]\!]^- = \{G : \text{any } g \in G \text{ is such that } \langle g/I(t_1)...g/i(t_n)\rangle \notin I(R)\}$

(120) a. $[\![\equiv (t_1...t_n)]\!]^+ = \{G :$for all $g, g' \in G$, if $g(t_1) = g'(t_1)...g(t_{n-1}) = g'(t_{n-1})$, then $g(t_n) = g'(t_n)\}$

b. $[\![\equiv (t_1...t_n)]\!]^- = \{G :$for all $g, g' \in G$, if $g(t_1) = g'(t_1)...g(t_{n-1}) = g'(t_{n-1})$, and $g(t_n) = g'(t_n)\}$

(121) a. $[\![\phi \wedge \psi]\!]^+ = \{G : G \in [\![\phi]\!]^+ \text{ and } G \in [\![\psi]\!]^+\}$

b. $[\![\phi \wedge \psi]\!]^- = \{G : G \in [\![\phi]\!]^- \text{ or } G \in [\![\psi]\!]^-\}$

(122) a. $[\![\phi \vee \psi]\!]^+ = \{G : G \in [\![\phi]\!]^+ \text{ or } G \in [\![\psi]\!]^+\}$

b. $[\![\phi \vee \psi]\!]^- = \{G : G \in [\![\phi]\!]^- \text{ and } G \in [\![\psi]\!]^-\}$

(123) a. $[\![\exists x\phi]\!]^+ = \{G : \text{there is a } G' \text{ such that } G[x]G' \text{ and } G' \in [\![\phi]\!]^+\}$

b. $[\![\exists x\phi]\!]^- = \{G : \text{all } G' \text{ satisfying } G[x]G' \text{ are such that } G' \in [\![\phi]\!]^-\}$

(124) a. $[\![\forall x\phi]\!]^+ = \{G : \text{all } G' \text{ satisfying } G[x]G' \text{ are such that } G' \in [\![\phi]\!]^+\}$

b. $[\![\forall x\phi]\!]^- = \{G : \text{there is a } G' \text{ such that } G[x]G' \text{ and } G' \in [\![\phi]\!]^-\}$

Now, we need only define negation (125) and truth and falsity (126):

(125) a. $[\![\neg\phi]\!]^+ = [\![\phi]\!]^-$

b. $[\![\neg\phi]\!]^- = [\![\phi]\!]^+$

(126) Let $\mathcal{M}$ be an FOD model and G a set of assignments. Then:

a. ϕ is True in $\mathcal{M}$ with respect to G iff $G \in [\![\phi]\!]^+$

b. ϕ is False in $\mathcal{M}$ with respect to G iff $G \in [\![\phi]\!]^-$

This does leave open the possibility of ϕ being *undefined* if it is neither true nor false.

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